

WEATHER AND CIRCULATION OF SEPTEMBER 1973

Record September Precipitation in the Great Plains and Rocky Mountains

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1. MEAN CIRCULATION

The mean 700-mb circulation over the Northern Hemisphere in September 1973 was characterized by three prominent amplified waves over middle and higher latitudes (figs. 1, 2). Mean troughs extended from polar Lows into the North Pacific Ocean, along the east coast of North America and near the Ural Mountains. Accompanying ridges were located across western North America, over western Europe and in eastern Asia. Subtropical ridges were stronger than normal around

much of the Northern Hemisphere, particularly over both the Atlantic and Pacific Oceans. The strength of the ridges, coupled with well-developed troughs to the north, produced fast, zonal 700-mb flow across mid-latitude oceanic areas (fig. 3). Wind speeds averaged 6 to 9 m/s faster than normal along the axis that stretched across the Pacific Ocean from China to near the United States. Wind speeds were not quite as strong along the axis that originated in the central United States, but did average 3 to 6 m/s above normal.

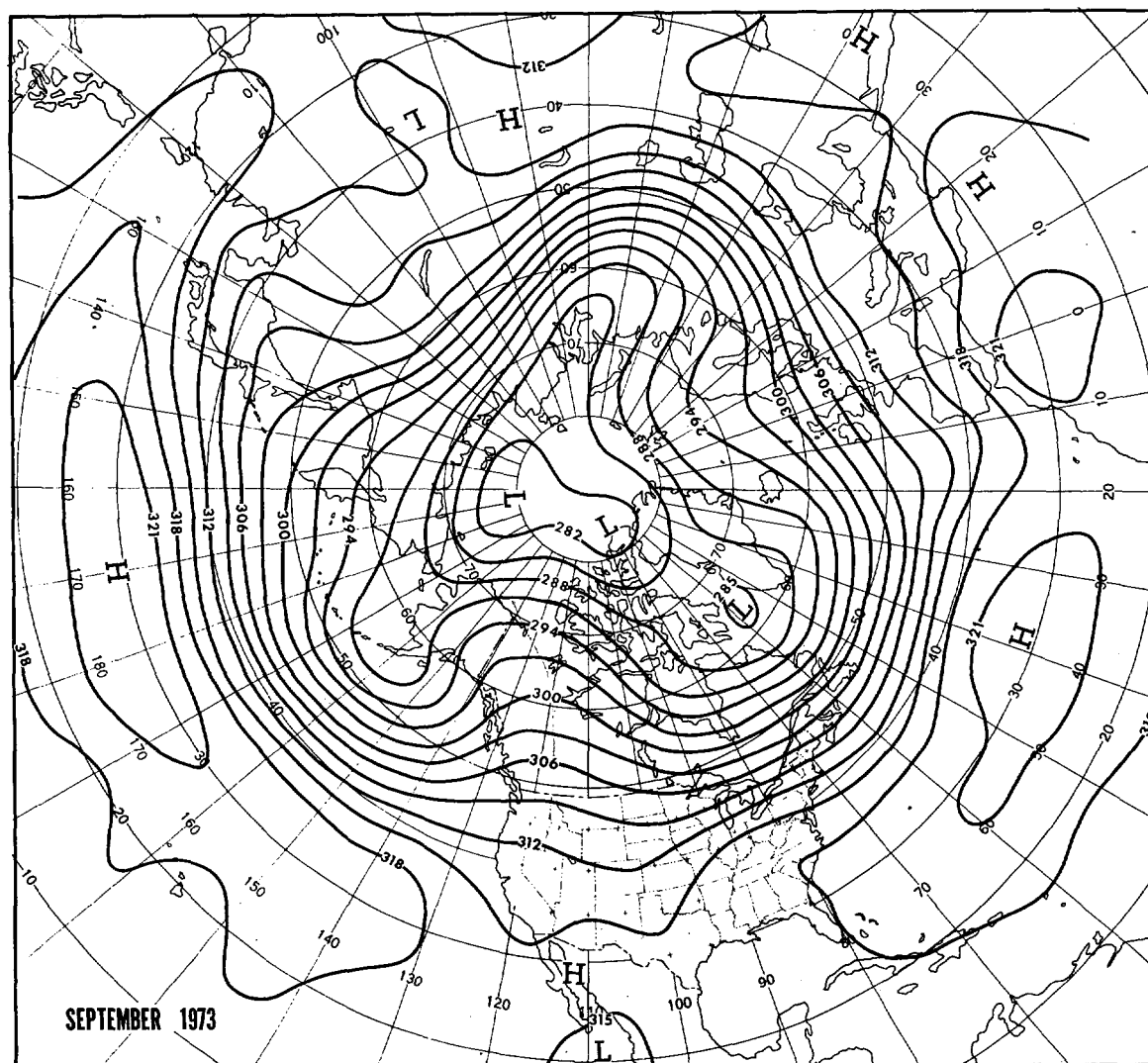


FIGURE 1.—Mean 700-mb contours in dekameters (dam) for September 1973.

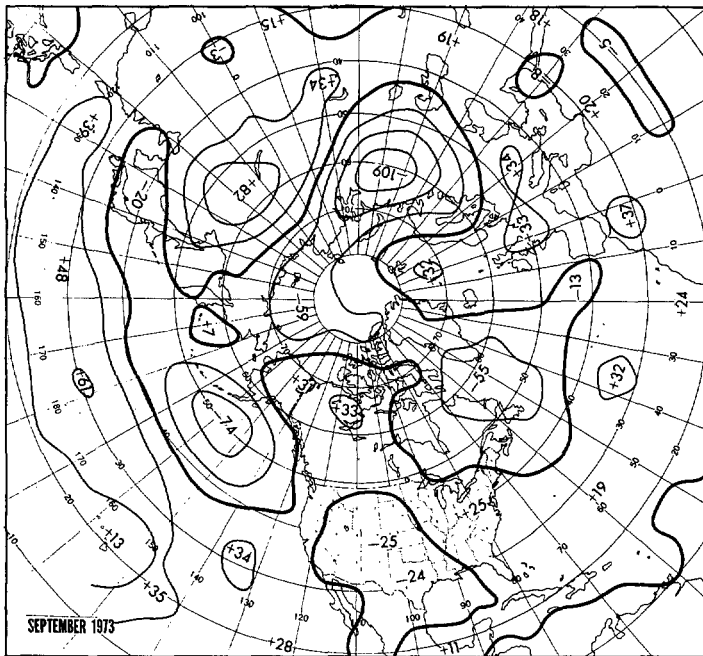


FIGURE 2.—Departure from normal of mean 700-mb height in meters (m) for September 1973.

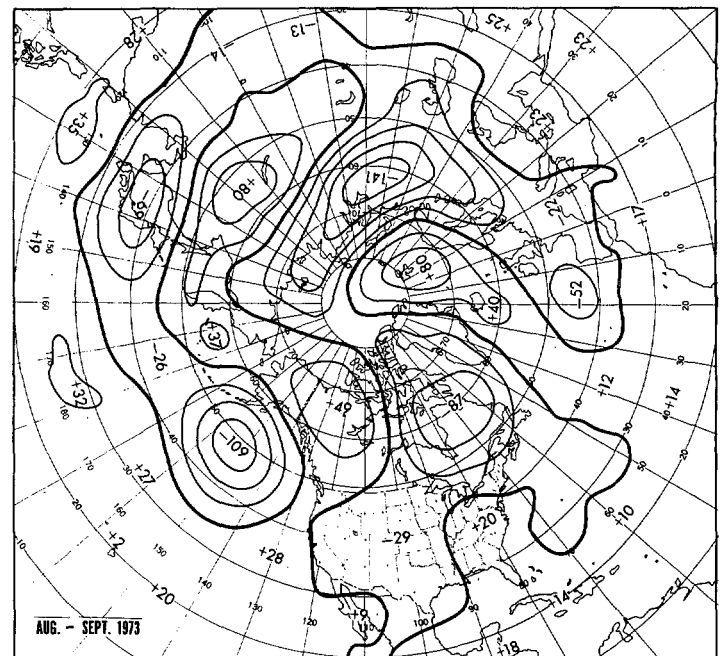


FIGURE 4.—Mean 700-mb height anomaly change (m) from August to September 1973.

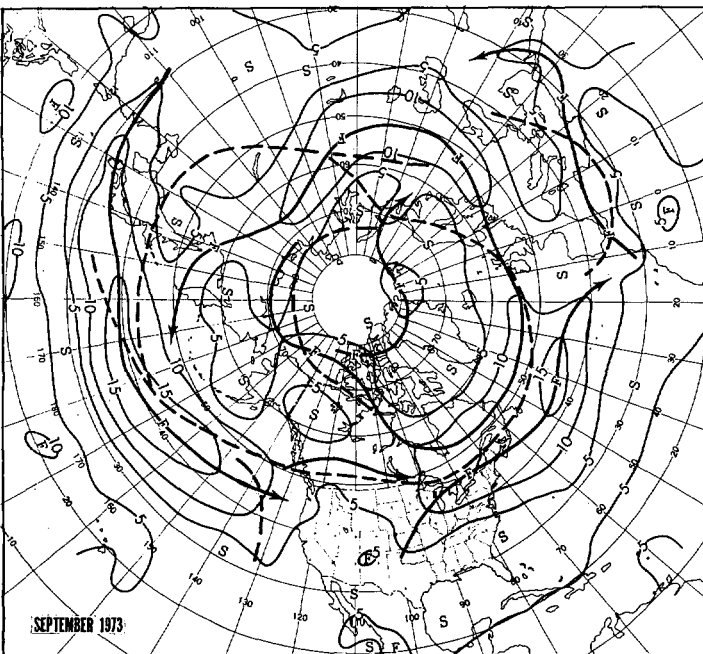


FIGURE 3.—Mean 700-mb geostrophic wind speed (m/s) for September 1973. Solid arrows show the observed axes of maximum wind speed, and dashed lines show the normal.

Principal wave components from central Asia to Western North America moved eastward in September from their mean locations in August 1973 (Dickson 1973). The presence of a well-amplified ridge over western Canada was accompanied by retrogression of the mean central Atlantic trough of August to the east coast of North America in September.

The wave phase over the United States during September was about the reverse of that over the rest of

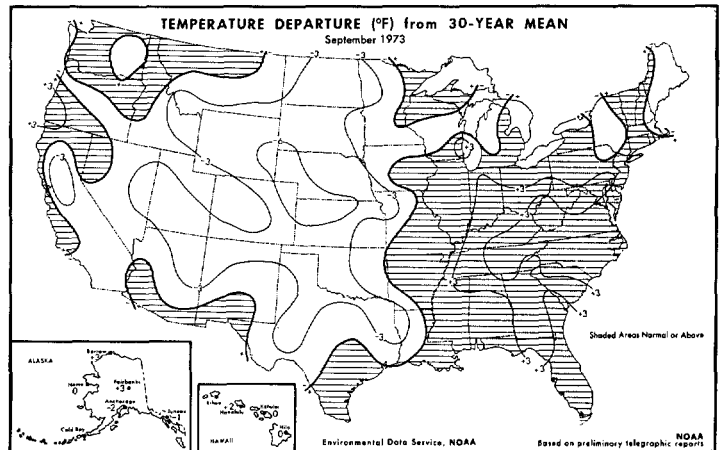


FIGURE 5.—Departure from normal of average surface temperature (°F) for September 1973 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service 1973).

North America. Mean height anomalies averaged below normal over most of the western half of the country as troughs were observed east of the Rocky Mountains and over southern California. An extension of the abnormally strong subtropical Atlantic ridge affected the eastern half of the Nation.

Although the southern portion of the European ridge showed little motion from August to September, the ridge built strongly to the north, replacing an August mean trough over northern Scandinavia. Major deepening occurred downstream from this ridge as a mean height became situated over the Ural Mountains. Mean height departures over the area fell by as much as 141 m from August to September (fig. 4). Wind speeds along the axis that extended through the trough to near the Sea of Okhotsk (fig. 3) were more than 5 m/s faster than normal.

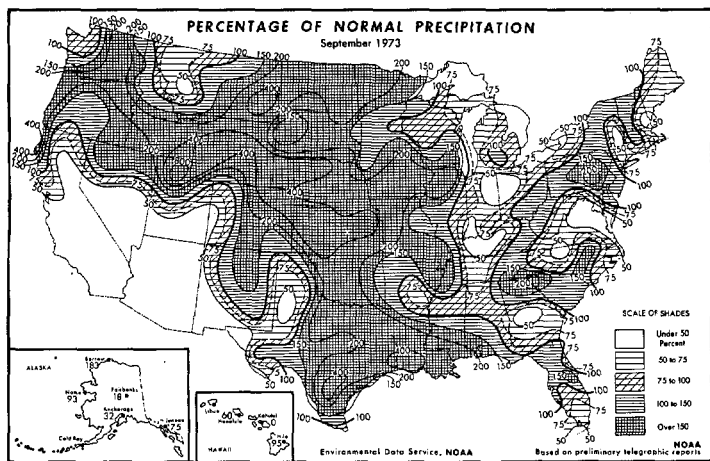


FIGURE 6.—Percentage of normal precipitation for September 1973 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service 1973).

2. TEMPERATURE

The pattern of the mean surface temperature anomaly that was observed over the Conterminous United States in September 1973 (fig. 5) was well related to the corresponding field of mean 700-mb height departures from normal (fig. 2.). Temperatures averaged higher than normal over most of the East in association with the mean ridge aloft. Contrariwise, below-normal heights over the West were accompanied by lower than normal temperatures at the surface with departures exceeding 3°F in much of the region. Temperatures did average higher than normal in part of the Northwest and along much of the Pacific coast.

Mean temperatures in Alaska were generally above normal over the northern two-thirds of the State where mean 700-mb heights were also above normal. Stations located in the southern one-third of Alaska, however, were cooler than normal during the month. Surface temperatures in the Hawaiian Islands were predominantly above normal.

3. PRECIPITATION

Monthly precipitation during September 1973 was abnormally heavy over much of the central United States (fig. 6); it occurred near a relatively deep, mean 700-mb trough (figs. 1, 2). The area of heavier than normal precipitation also included parts of the Central and Northern Rocky Mountains as well as the Pacific Northwest where a long-standing drought has been in progress. September precipitation totals were of record or near-record values at a number of stations located within this zone of above-normal precipitation (table 1).

Elsewhere over the country, rainfall was less than one-half the normal September amount in much of the Southwest while east of the Mississippi River the pattern of precipitation was quite variable. Precipitation amounts

TABLE 1.—Record and near-record precipitation totals observed during September 1973

Station	Amount (in.)	Anomaly (in.)	Remarks
Little Rock, Ark.	9.09	+5.86	Wettest September since 1913
Pocatello, Idaho	2.29	+1.68	Wettest September since 1940
Dodge City, Kans.	6.80	+5.27	Wettest September since 1906
Topeka, Kans.	12.71	+9.73	Wettest September back to 1888
Alexandria, La.	9.53	+6.40	Wettest September since 1913
Baton Rouge, La.	13.08	+9.56	Wettest September since 1877
Lake Charles, La.	19.96	+15.94	Wettest September
Grand Island, Nebr.	8.39	+6.24	2d wettest September
Sexton Summit, Oreg.	3.10	+1.85	Wettest September
San Antonio, Tex.	13.09	+9.60	2d wettest September and 2d wettest month
Salt Lake City, Utah	4.07	+3.54	Wettest September back to 1874
Casper, Wyo.	3.28	+2.38	Wettest September
Cheyenne, Wyo.	4.52	+3.42	Do.
Lander, Wyo.	4.68	+3.65	2d Wettest September back to 1878 and wettest since 1923
Flagstaff, Ariz.	trace	-1.58	Equalled driest September in 75 yr of record
Phoenix, Ariz.	0.00	-0.73	Only 4th September without measurable precipitation
Fort Wayne, Ind.	0.70	-1.97	Driest September since 1940

at most stations in Alaska and Hawaii were near to below normal.

4. WEEKLY VARIABILITY

September 3-9

Generally, the mean 700-mb circulation during the first week of September bore a close resemblance to the mean monthly pattern (figs. 1, 7A). The Low over Texas was affiliated with tropical storm Delia.

Weekly mean temperature departures from normal were similar to those of the entire month (figs. 7B, 5). The warmth over the eastern half of the Nation during the week of September 3-9 was a continuation of the heat wave that began in late August (Dickson 1973). A number of daily maximum temperature records were established in the Northeast where some daytime temperatures exceeded 90°F through September 5. Colder air then pushed through the region and reduced temperatures to more seasonable levels.

Tropical storm Delia was the principal source of much of the heavy precipitation during the first week of September (fig. 7C). Although the storm center never got further north than central Texas, moisture advected from the area of the storm brought more than 6 in. of rain to eastern Texas and the Lower Mississippi Valley. Weekly rainfall totaled 10.59 in. at Lake Charles, La. A cold front that moved across the Mississippi Valley at about the same time also helped to trigger rainfall over the area.

September 10-16

A strongly amplified wave pattern characterized the mean 700-mb circulation during the second week of September (fig. 8A). This amplification occurred in con-

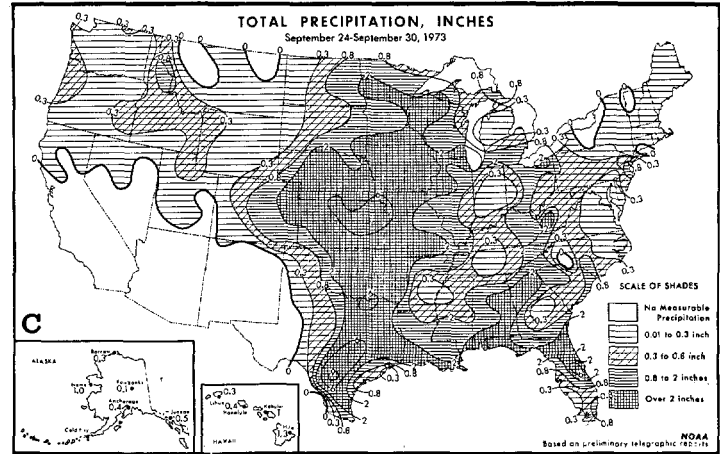
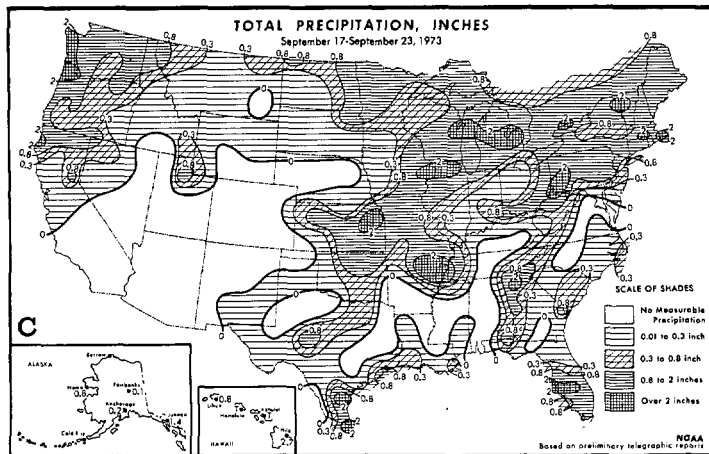
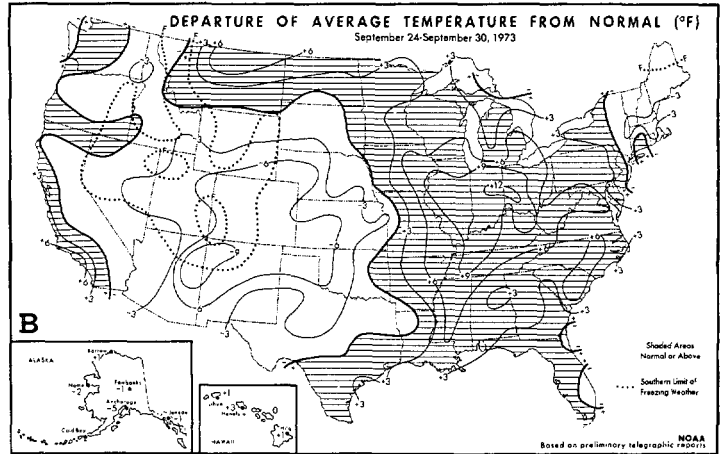
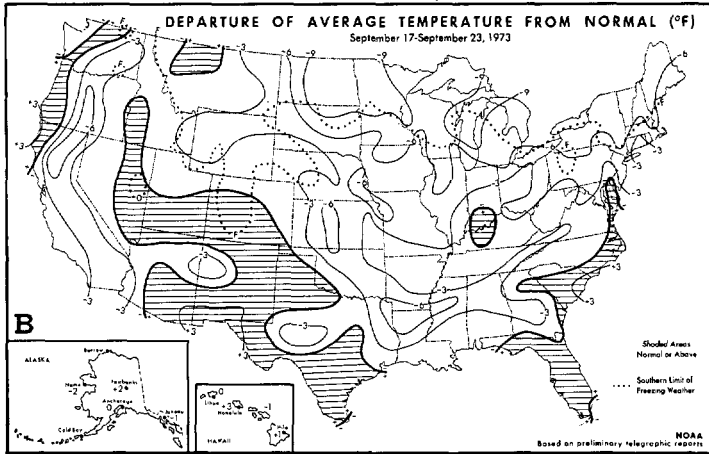
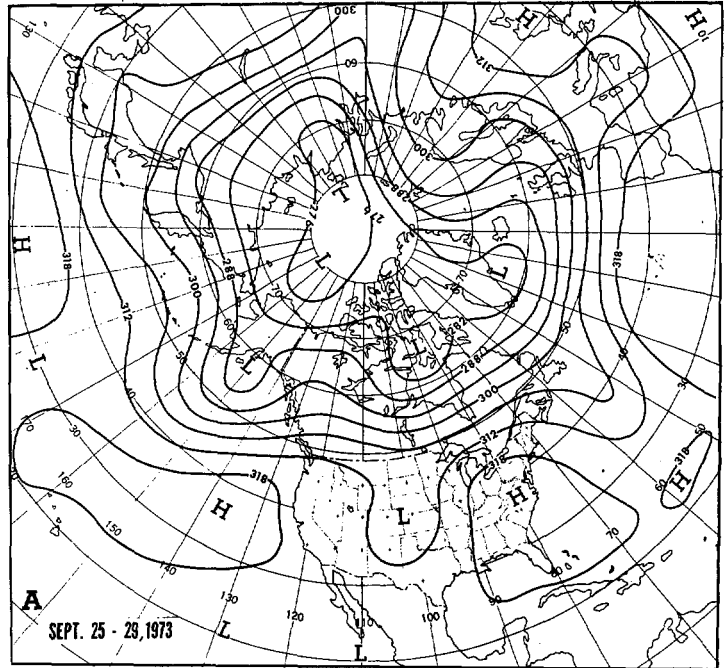
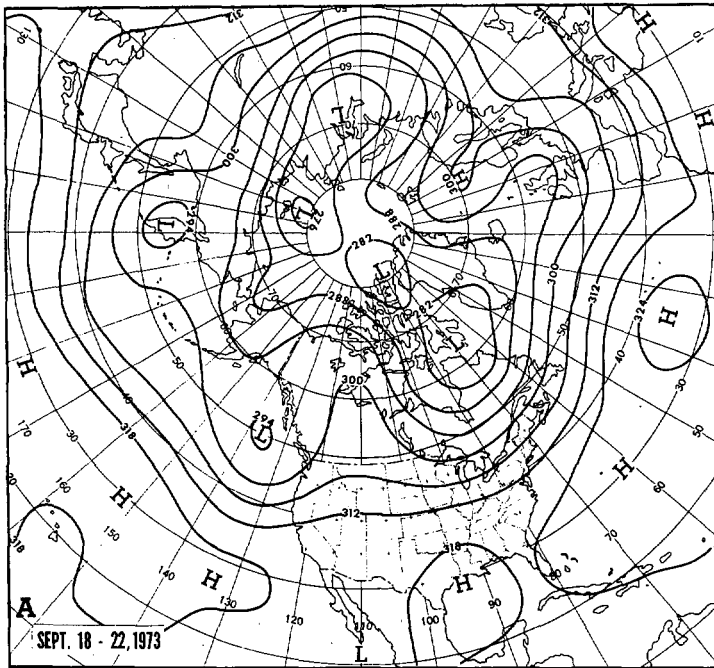


FIGURE 9.—Same as figure 7, (A) for Sept. 18–22, 1973; (B) and (C) for week of Sept. 17–23, 1973.

FIGURE 10.—Same as figure 7, (A) for Sept. 25–29, 1973; (B) and (C) for week of Sept. 24–30, 1973.

remained in part of the Southeast and also prevailed west of the Rocky Mountains.

Heaviest precipitation occurred along the Gulf and Atlantic coasts this week (fig. 8C). This rainfall was primarily associated with a weak tropical Low that moved

into southeastern Texas early in the week. Weakening as it slowly moved northeastward, the Low merged with a complex frontal system in the Carolinas later in the week. This system deepened rapidly near the coast on the 14th and then moved northeastward.

Although the mean 700-mb circulation was still quite amplified at higher latitudes, the flow at mid-latitudes was more zonal than it had been in the previous week (fig. 9A). A mean Low was now situated over Kamchatka Peninsula while major components of the downstream wave train were displaced eastward from their previous positions. However, the trough over eastern Canada retrograded slightly.

Weekly mean temperature anomalies across the United States (fig. 9B) were not greatly different from those of September 10-16. In general, departures were somewhat negative over the East and were a bit positive in the West. Interior valley regions from Washington to California experienced strong cooling, however.

Weekly precipitation totals (fig. 9C) were generally heaviest in the northeastern quarter of the country and in the Pacific Northwest in connection with adjacent mean troughs. This was the wettest week of the month in the droughty Northwest.

September 24-30

The mean 700-mb circulation during the last week of September featured closely spaced, moderately amplified waves around the hemisphere at mid-latitudes (fig. 10A). A sharp trough prevailed over the Gulf of Alaska while downstream a ridge affected western North America. A mean trough stretched southwestward from a Low near Baffin Island to another Low over the central United States. A ridge extended northward from a High over the Carolinas.

A strong east-west temperature anomaly gradient occurred this week in the center of the country (fig. 10B). Warmer than normal air covered most of the eastern half of the Nation in response to the mean 700-mb ridge over the East and warm air advection in advance of the Great Plains trough. Below-normal temperatures predominated over much of the West where the mean flow aloft was from the north. Higher than normal temperatures in the West were confined to the northern border and along the west coast. New England, which lay to the east of the mean ridge, was slightly colder than normal.

Precipitation was quite heavy in the central part of the country (fig. 10C) in the region of the mean 700-mb trough. Many stations within the area received more than 2 in. of precipitation during the week. Some of this precipitation was accompanied by severe weather as squall lines developed along a stalled cold front. Kansas was particularly hard hit as 24 tornadoes were reported in the State during the 2-day period, September 24-25. The most tornadoes recorded in Kansas during any previous September was only eight (National Oceanic and Atmospheric Administration 1973).

5. TROPICAL ACTIVITY

Tropical activity continued to be relatively sparse over both the North Atlantic and North Pacific Oceans as it had been in August. Cyclones that reached at least tropical storm strength in September included Cristine and Ellen in the Atlantic Ocean and Delia in the Gulf of Mexico. Heather and Irah formed in the southeastern section of the North Pacific while Louise and Marge spent their lives in the southwestern part of the same ocean.

Tropical storm Cristine, which formed in the southern North Atlantic late in August, moved westward during the first few days of September and dissipated near the Leeward Islands by the 4th. Hurricane Ellen developed from a weak disturbance that was located near 10°N, 25°W, on September 15. The Low moved northwestward and continued to deepen until it reached hurricane force near 27.5°N, 52.5°W, on the 20th. It then turned abruptly northward and passed well east of Bermuda. Ellen remained a hurricane until the 22d; but by the next day the storm had become extratropical.

A weak Low, destined to become tropical storm Delia, was located near the east coast of the Yucatan Peninsula on September 1. The Low deepened and moved northward, reaching tropical storm force near mid-Gulf of Mexico on the 2d. Delia reached the Texas coast on the 5th where it lingered before moving inland on the 6th. The storm then moved westward across Texas and died over northern Mexico.

Heather, which was left over from August, quickly dissipated along the coast of southern Mexico on the 2d. Hurricane Irah was positioned near 20°N, 110°W, on September 24. It moved northward across the southern tip of Baja California and reached the coast of Mexico on the 26th. This storm gave some concern to forecasters who, at the time, were making weather and sea-state predictions for the splashdown of Skylab 2 on September 25. Fortunately, the storm remained out of the critical recovery area.

Only two storms reached at least tropical storm intensity in the southwestern North Pacific during September 1973. The storms, Louise and Marge, followed similar tracks from near Luzon in the Philippines westward to the coast of North Vietnam. Louise was active in the period from September 3 to 7 and Marge existed during September 12-15.

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